Experimental Measurements of the Dynamic Viscosity of Dense Gases by Means of the Electromagnetic Alternating Piston Technique

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In this work, an experimental setup implementing an electromagnetic alternating piston sensor (Cambridge Applied Inc. SPL440) is described for the measurement of the dynamic viscosity of gases and gas phase mixtures, in the range from 0.02 to 0.2 cP, up to high pressures (e. g. 70 MPa) and between 278 K and 443 K. The apparatus features the possibility to set the inclination of the sensor with an uncertainty of about 0.1°. The effects of the sensor inclination on the measurements on gases is analyzed and the calibration of the instrument with high purity carbon dioxide and ethane as reference fluids is especially discussed. For pure gas as CO_2 or ethane, or mixtures containing for instance CO_2 plus a co-solvent, the viscosity range of operation allows to study the effect of pressure on the viscosity in the transition between light and dense phases at supercritical temperatures. Measurements of the viscosities of the system CO_2 (1) + Ethanol (2) at in $x_1 \sim 0.85$ mole fraction are reported in the pressure range from 1 to 70 MPa. The experimental data are correlated and compared with those available in the literature.